

US EPA ARCHIVE DOCUMENT

Ecosystem services altered by human changes in the N cycle: A new perspective for decision-making

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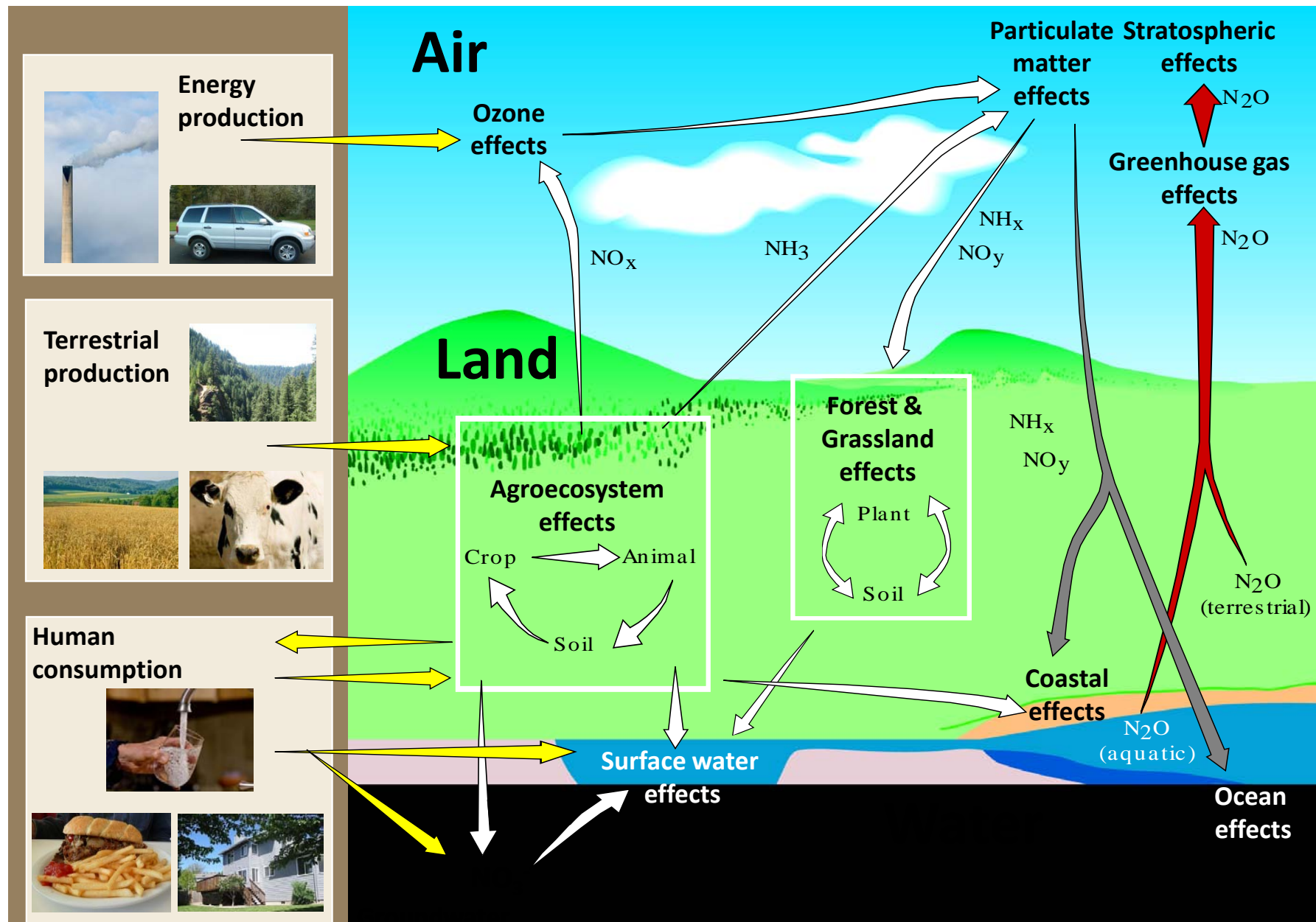
Ecosystem services (ES)

- the aspects of ecosystems used to produce human well-being (Fisher et al. 2008 *Ecol Apps*)

Goal of our work

- use N cascade to connect nitrogen impacts to ES
- present economic valuation estimates if possible
- discuss climate-N interactions in ES

The nitrogen cascade



Effects of nitrogen on air ecosystem services

Clean Air

Reduced visibility

Human respiratory health

Human respiratory health

Crop production declines - ozone

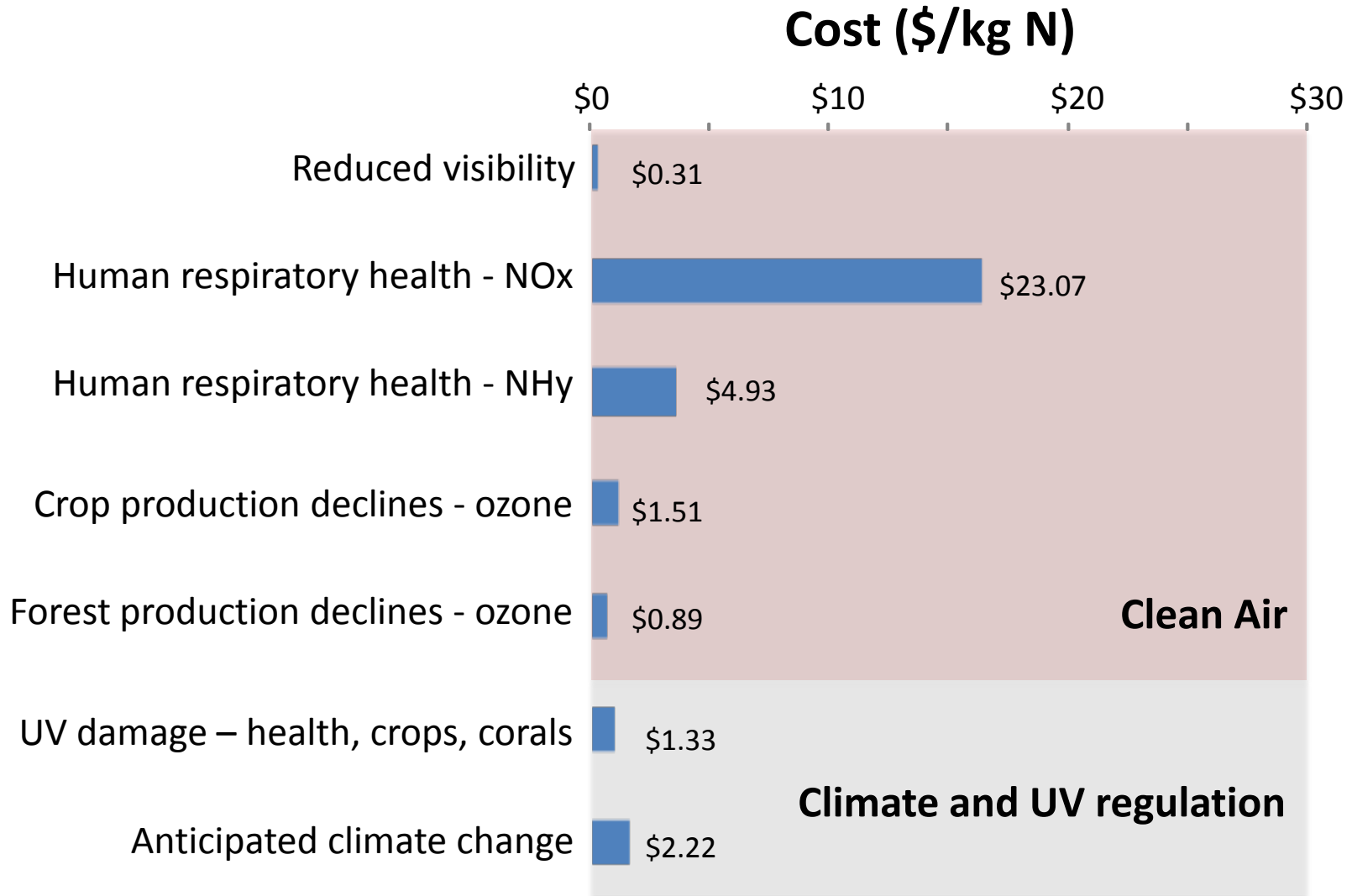
Forest production declines - ozone

Climate and UV regulation

UV damage – health, crops, corals

Anticipated climate change

Damage to air ecosystem services



Effects of nitrogen on water ecosystem services

Freshwater ES

Reduced lakefront property values
Impairment of boating access
Freshwater endangered species
Cost of HABs (swimming, drinking)

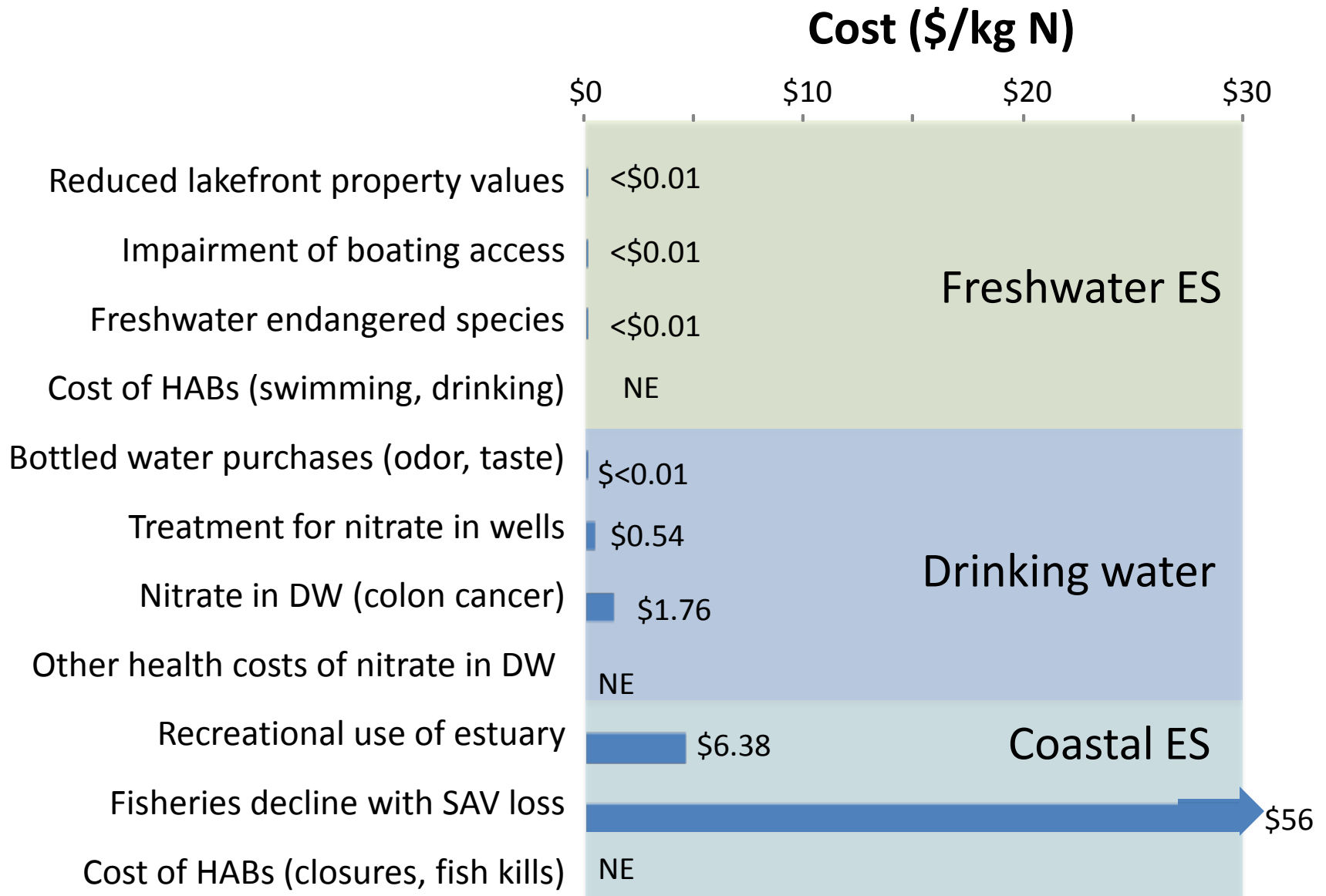
Drinking water

Bottled water purchases (odor, taste)
Treatment for nitrate in wells
Nitrate in DW (colon cancer)
Other health costs of nitrate in DW

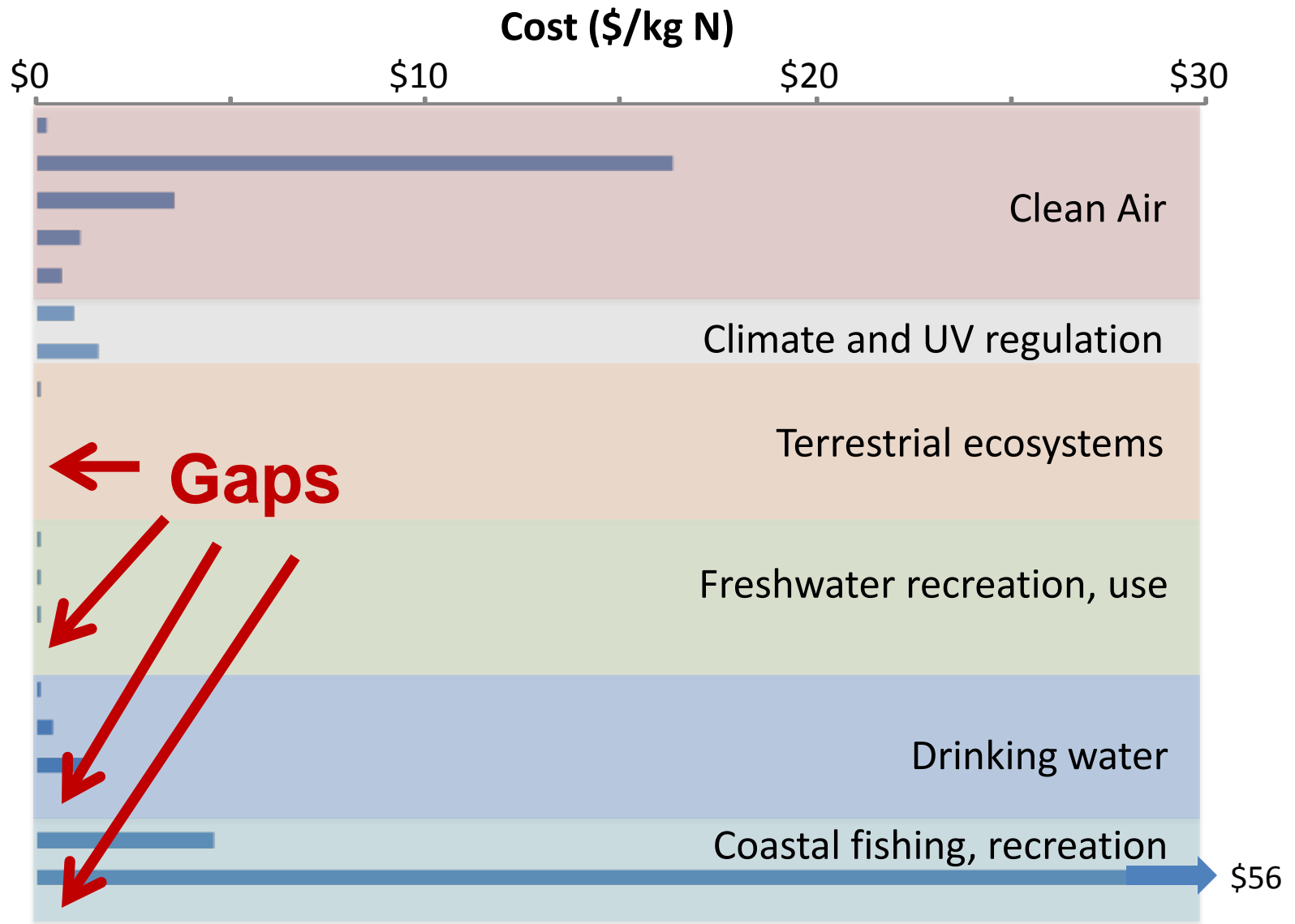
Coastal ES

Recreational use of estuary
Fisheries decline with SAV loss
Cost of HABs (closures, fish kills)

Damage to water ecosystem services



Effects of nitrogen on ecosystem services



Costs of abatement or mitigation

\$ kg⁻¹ N

By source

Electric utilities/NO _x	\$4.80
Industrial/NO _x	\$22.00
Mobile sources	\$14.00
Non-agricultural/NH ₃	NE
Agriculture/NO ₃	\$10.00
Urban and mixed land use/NO ₃	\$96.00
Point Sources	\$18.00
Agricultural drainage water/NO ₃	\$2.71

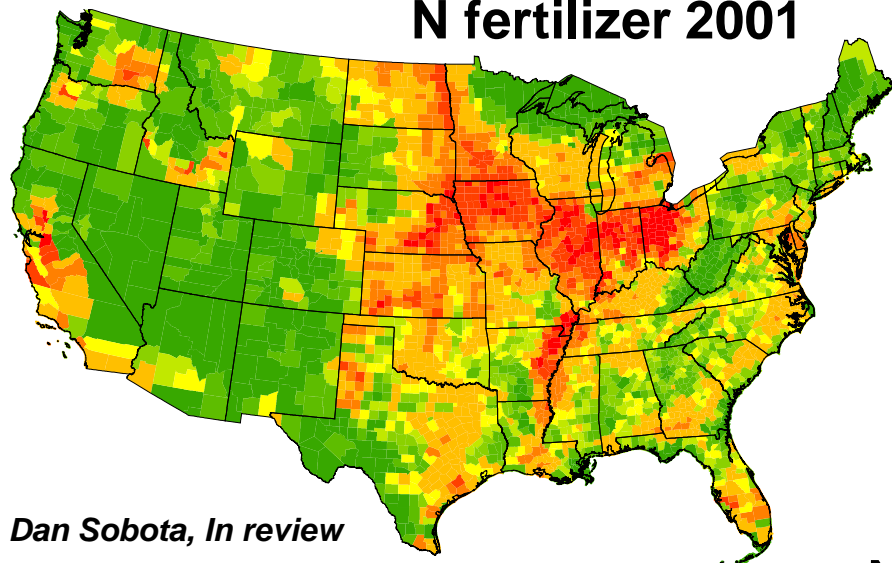
Integrated plans

Current expenditures towards meeting Chesapeake TMDLs – (1985–2009)	\$8.76
Projected costs to meet Chesapeake TMDLs – (2010–2025)	\$14.27
Projected costs of using wetlands to control nutrient damages	\$4.40–5.62
Estimated cost for achieving a 45% reduction in nitrate-N load	\$2.50

NE = no estimate.

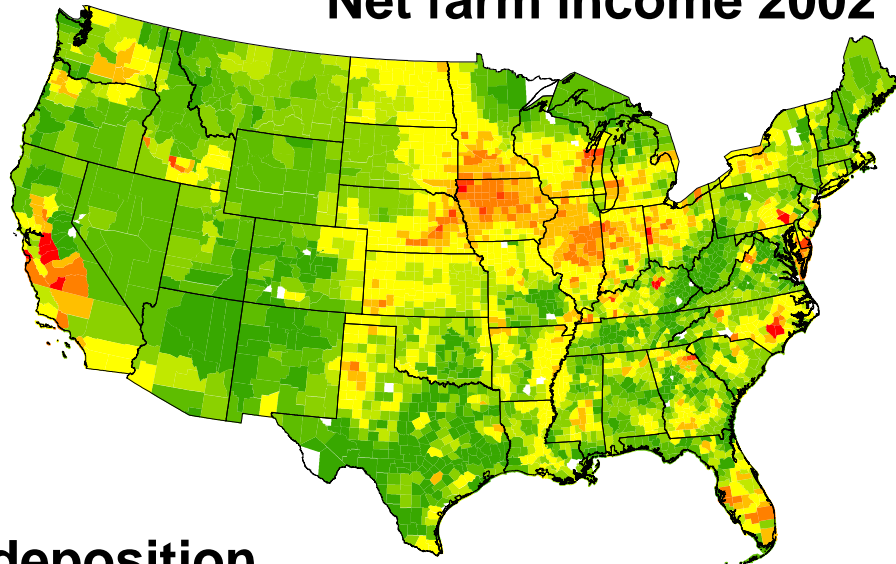
Links between N and other services

N fertilizer 2001

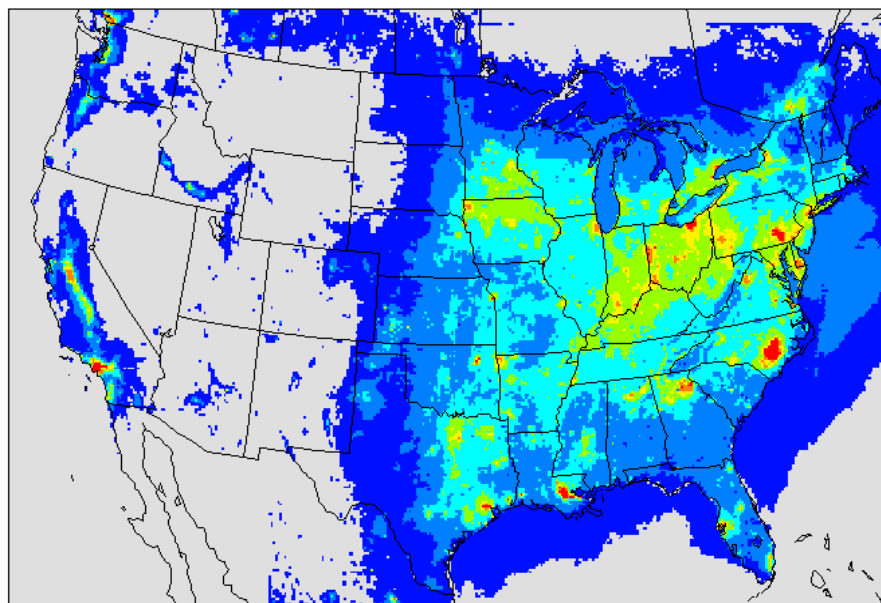


Dan Sobota, In review

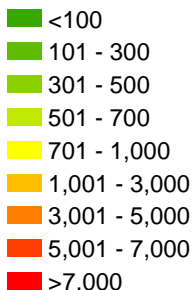
Net farm income 2002



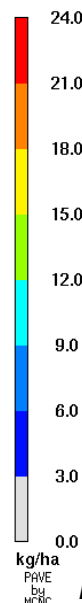
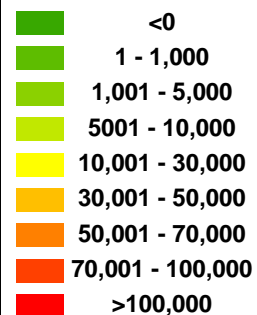
N deposition



N Fertilizer Input
(kg/km²/yr)

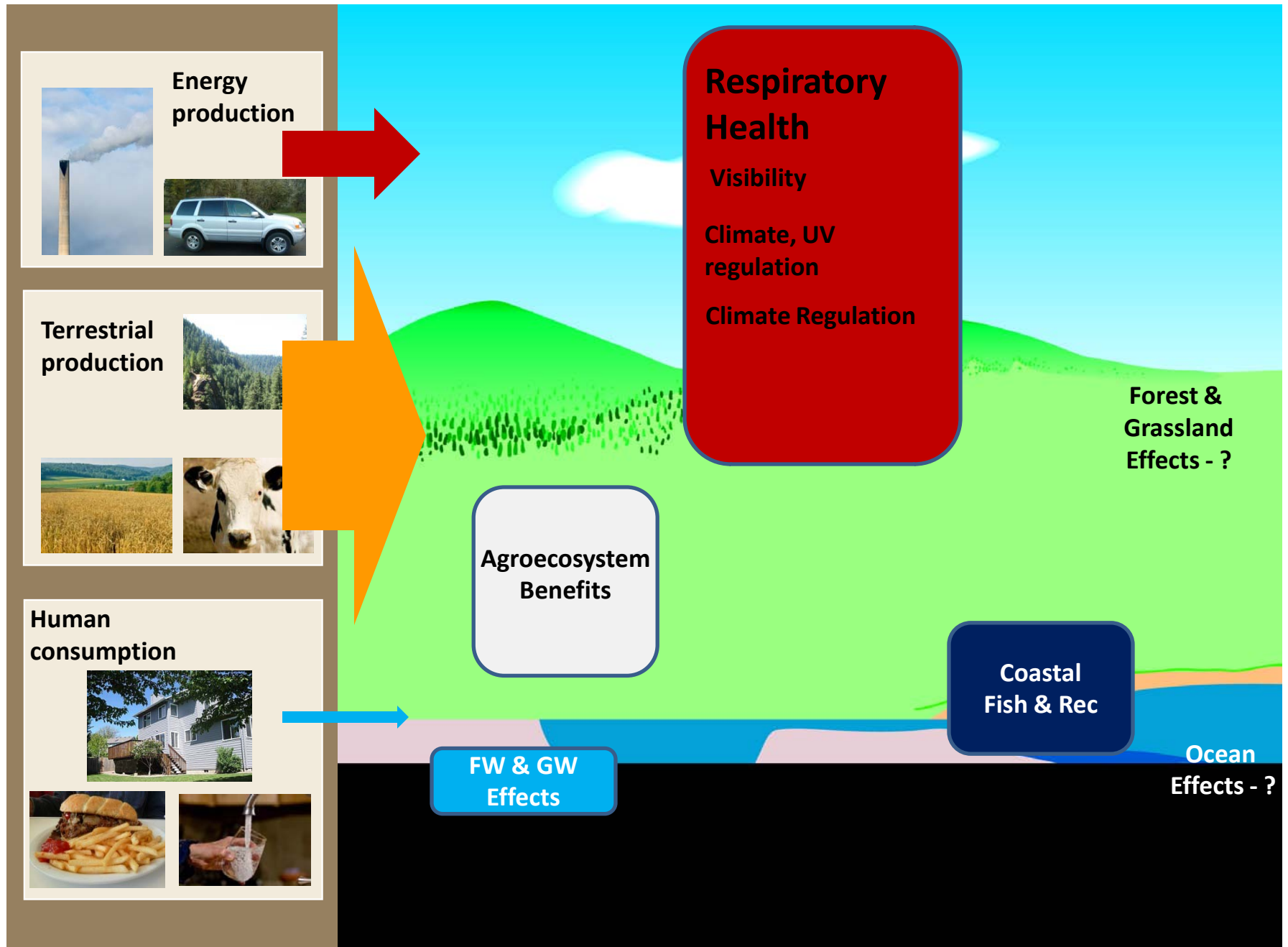


Net farm income
(\$/km²)

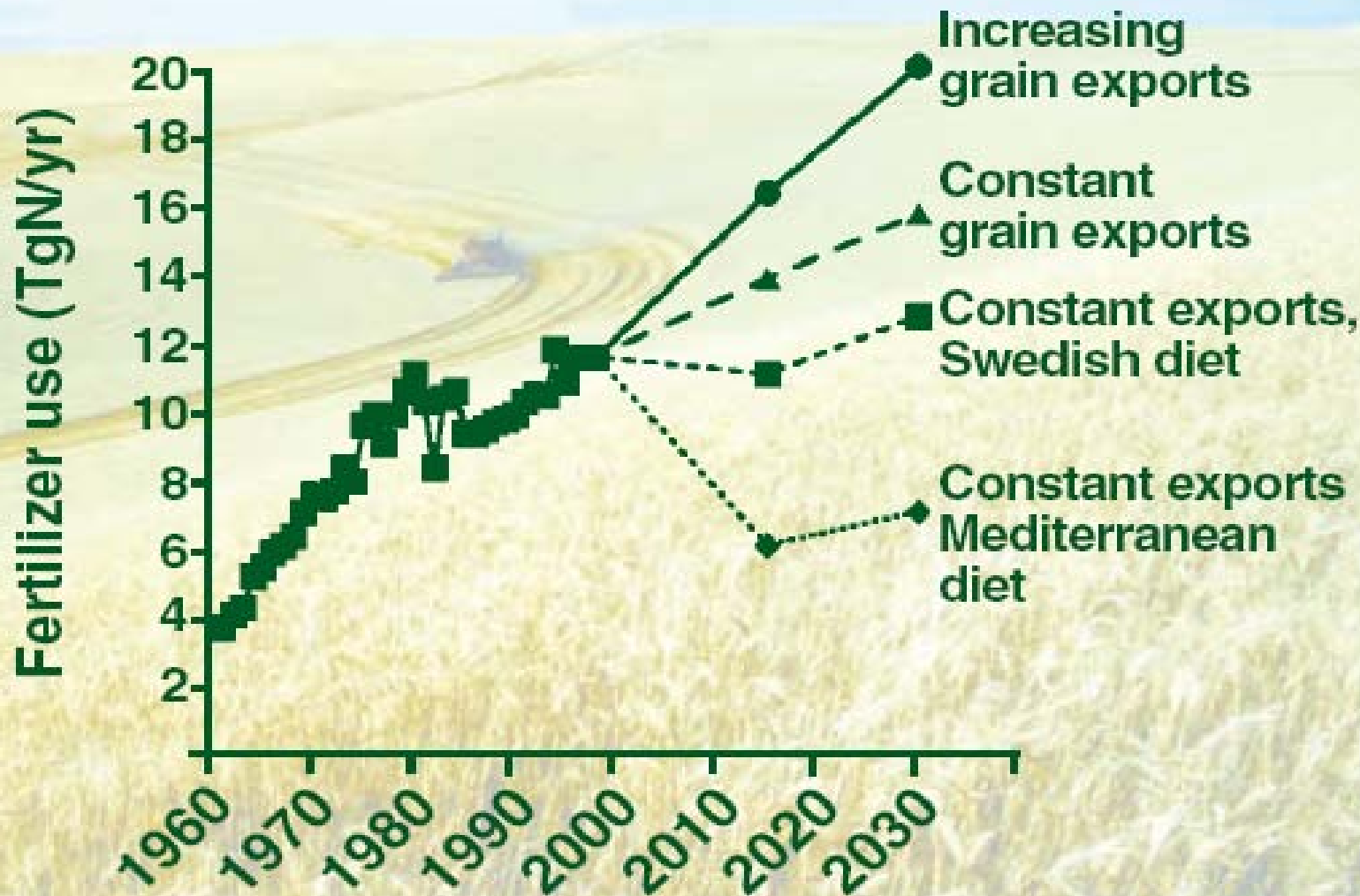


Robin Dennis, EPA NERL

The nitrogen cascade



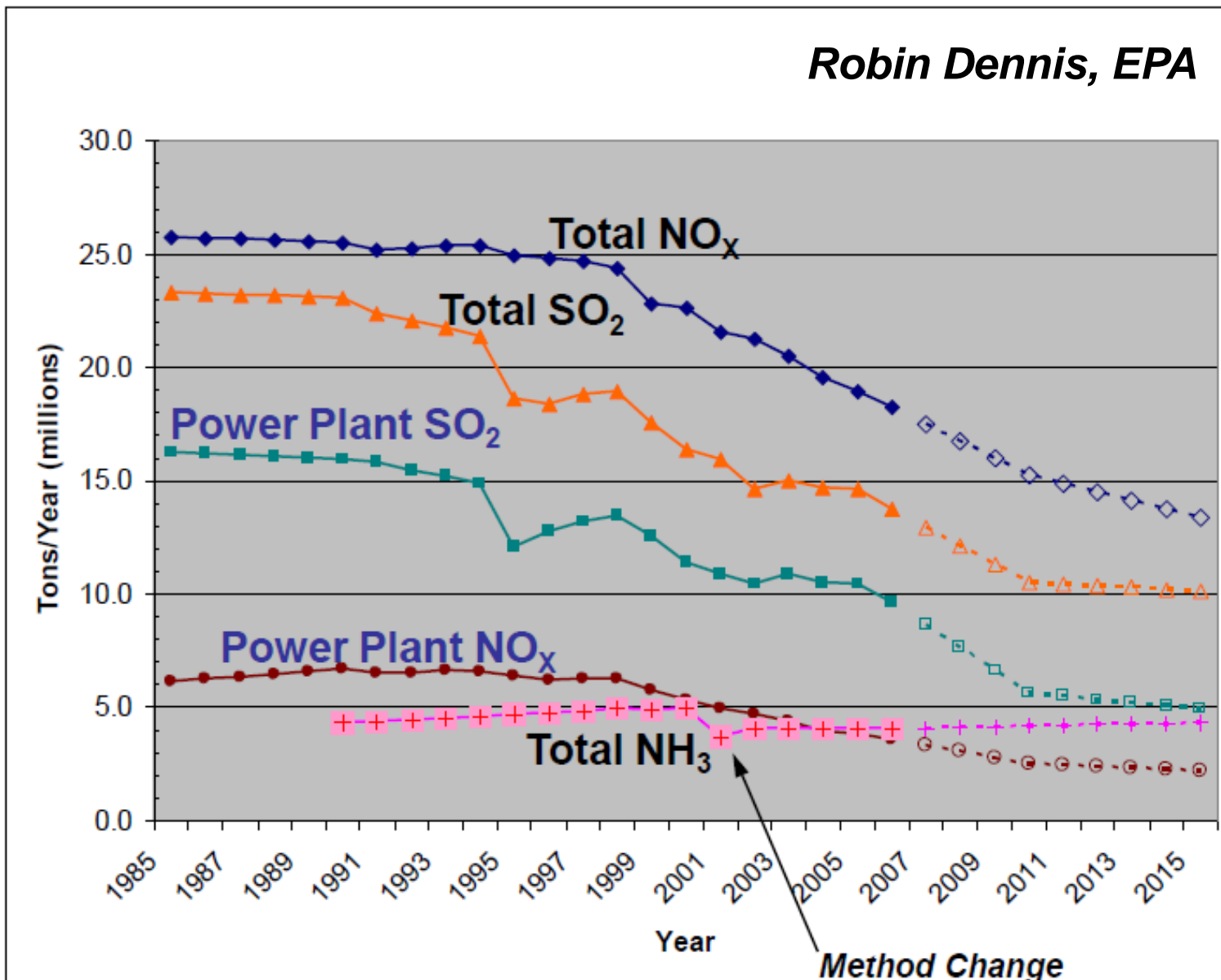
Nitrogen in the future



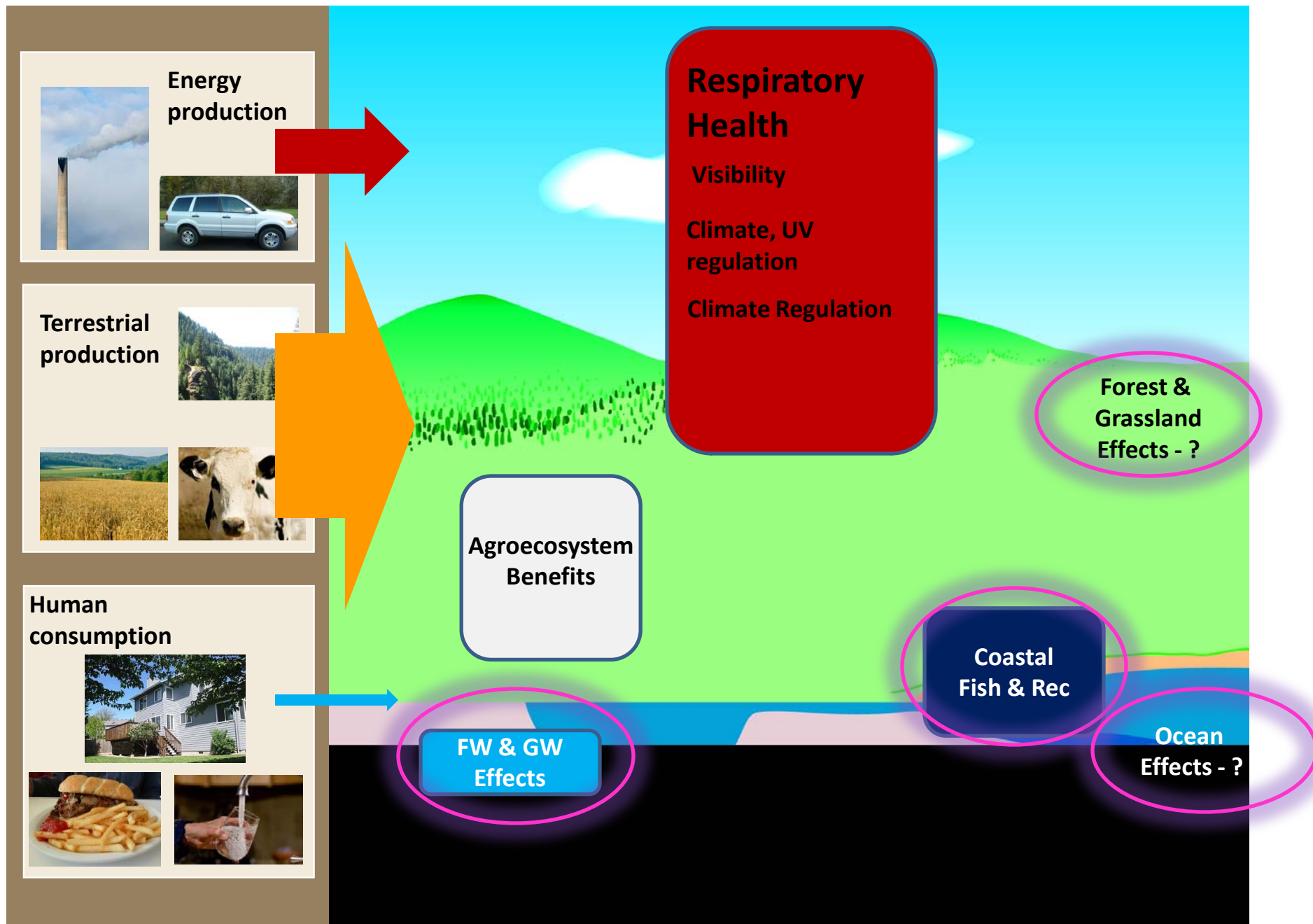
from Townsend et al. 2004 FIEE

NO_x, SO₂ and NH₃ National Emissions Trends

Robin Dennis, EPA



The nitrogen cascade



Conclusions

Current impact of nitrogen on ES

- Human health air effects dominate
- Some effects on fisheries production are very large
- Many impacts not valued or only 1 data point
- Damages generally greater than abatement costs
- Uncertainties about transferability of functions

What information on impacts is needed?

- Freshwater and HABs
- Drinking water
- Fisheries
- Recreation and non-use values

Climate change and N interactions expected to impact forests and grasslands, and most aquatic services.



**For more information →
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